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ABSTRACT

The Montgomery County, Maryland Public Schools, working with Operations Research, Incorporated, developed a Pupil Master File (PLMF). PLMF is one of the several applications included within the Pupil Subsystem of the district's overall computerized School Information System. The PLMF is designed to provide: 1) a master file which enables users to implement the pupil data system; and 2) interface capability with other subsystems. It protects the confidentiality of sensitive data, provides retrieval access to the entire system, and facilitates input, output, and file expansion. PLMF uses COBOL software and is implemented on IBM S/370 equipment. The application is used to measure educational progress, to supply data for planning and projections, to generate data for research purposes, and to supply teachers with pupil profiles to aid classroom decision-making. Since PLMF ties several applications of the Pupil Subsystem together, thereby reducing errors and increasing efficiency, it is judged a useful tool for the educational administrator. (PB)

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PUPIL MASTER RECORD SYSTEM --

HISTORY AND OUTLOOK

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WHY A MASTER RECORD SYSTEM?

The history of a school district's centralized information systems, whether automated or manual, may be characterized usually by one word - expediency. Each application is set up when it is needed and in response to a particular state regulation, a new school policy, or some district-wide opportunity to save money.

Since each application is developed to satisfy a particular need, they are usually developed independently. In the example we will be using, Montgomery County, Maryland, there was a Pupil Accounting (Attendance) Application developed when the economics were right for a county-wide system.

Ultimately, a Pupil Scheduling application was developed in order to use the power of a modern computer to schedule junior and senior high students. Similarly, a Pupil Testing Application came into being to score test papers. At present Pupil Performance Reporting and Health Data Applications are on the drawing boards.

Let us consider for a moment the impact of 5 such applications, each serving a particular purpose. Figure 1 is one of six pages from a chart we prepared of data used within the County. This, we feel, is typical of the situation faced by school districts who attempt to satisfy local administrative needs as well as respond to state requirements. The redundancy in data from form to form and application to application is apparent. In any system where duplication occurs the impacts of cost and volume are usually obvious; less obvious is the fact that with so many kinds of data paralleling each other the opportunity for errors caused by failure to replicate corrections of "fixes" is enormous. For example, if Johnny James transfers from school A to school B, maybe the Attendance and Scheduling Applications will be updated but what are the chances each of the other applications will be updated -- and that the update will be correctly applied in each case?

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Data Element	Input																							Output							
	FDS 1	FDS 2	FDS 3	FDS 4	FDS 5	FDS 6	FDS 7	360-27	360-7	310-49	310-48	310-2	310-7	310-26	310-34	360-19	325-1	340-1	365-2	CR-1	CR-4	CR-5	CR-9	280-4	310-12	310-39	310-41	Class List	Student List	Masters Schedule(s)	APTS Reports	SAT Master File Tape	Master Test Record Tape	Scheduling Tape
PERSONAL DATA																																	
Pupil I.D. no.	X	X	X	X	X	X	X	X	X		X								X					X	X	X	X	X			X		X
Birth date	X	X		X	X	X	X	X								X	X	X	X	X		X		X	X	X					X		
Social security no.	X	X																															
Name (F, L, M)	X	X	X	X	X	X	X	X	X		X		X			X	X	X	X	X	X	X		X	X	X	X	X	X		X		X
Other name	X	X	X	X	X	X	X																										
Sex	X	X	X	X	X	X	X	X					X			X		X	X	X		X			X	X			X		X		
Race	X	X	X	X	X	X	X	X					X			X				X		X									X		
Marital status	X																																
No. of children	X																																
Citizenship	X																																
Foreign language spoken	X																				X												
Birth certification	X																			X													
Place of birth	X																			X													
Residence of female parent at time of birth																																	

FIGURE 1 Excerpt From Data Element Analysis/Montgomery County

Type of Output	Name of Output Document	Expected Utility							Enhancing Layout Features	Figure Showing Layout
		Teachers	Counselors	Curriculum	Principals Asst Supt	Pupil Services	Testing	Research		
Pupil Reports (Scheduled)	Transcript	Reduce administrative burden			Reduce administrative burden				Consists of buildup of data from the report cards	
	Report Cards	Reduce administrative burden			Reduce administrative burden					18
Educator Reports (Triggered)	Pupil Profile	Reveal pupil needs	Reveal pupil needs	Reveal curriculum needs	Evaluate area, school, teacher performance	Reveal pupil service needs	Evaluate standard tests effectiveness	Analysis	Facilitates review of pupil characteristics in a single scan of one line of data	19
	Teacher/Grade Distribution		Evaluate teacher performance		Evaluate teacher performance	Evaluate teacher performance		Analysis		20
	Scheduling (Current Roster)	Ease record-keeping	Locate pupils		Facilitate roster control	Locate pupils	Locate pupils		See below	
	Intracounty Transfers				Facilitate roster control				Format matches scheduling output to facilitate cross-reference	21
	Ranking	Reveal pupil needs	Reveal pupil needs	Reveal pupil needs		Reveal pupil service needs		Analysis		22
	Attendance Exception		Reveal pupil problems		Reveal pupil problems	Reveal pupil problems		Analysis	Space for unusual attendance pattern flags anomalies	23
	Extracurricular Activity Ineligibility		Reveal pupil problems		Identify ineligible pupils	Reveal pupil problems		Analysis		24
	Scheduling Exception		Reveal pupil needs		Reveal pupil needs	Reveal pupil needs		Analysis	Expected year of graduation indicates scheduling urgency	25
	Grading Exception		Reveal pupil needs		Reveal pupil needs	Reveal pupil needs		Analysis		26
	Health Exception		Reveal pupil needs		Reveal pupil needs	Reveal pupil needs		Analysis	Facilities match of pupils with multiple exceptions	27
	Class Profile	Reveal class problems	Reveal pupil needs and class problems	Reveal curriculum needs	Reveal class problems	Reveal class problems	Evaluate standard test effectiveness	Analysis	Shows potential achievement level of class vs actual	28

FIGURE 2 Excerpts From an Analysis of Output Reports

MONTGOMERY COUNTY SCHOOL SYSTEM PUPIL INFORMATION PROFILE

School Number 9999
Teacher Number 9999
Source Number 9999
Section 99

Pupil I.D.	Pupil Last Name:	First Name	Middle Initial	Sex	Birth Date: Month	Birth Date: Day	Birth Date: Year	Grade	Race	Language Other than English Spoken by Pupil	Telephone No.	Male Relation - Female Relation	Number of Brothers and Sisters	Other Language Used in Home	Defects: Vision	Defects: Hearing	Defects: Impairment	Limitation	Psychological	Test Scores: I.Q.	Test Scores: Reading	Test Scores: Mathematics	Other	Prior Attendance: Absent	Prior Attendance: Present	Head Start
9 9 9 9 9	x x x x x x x x x x x x x x x	x x x x x x x x x x x x x x x	x	x	9 9	9 9	9 9	9 9	9	x x	9 9 9 9 9 9 9	x	9 9	x x x	x	x	x	x	x	9 9 9	9 9 9	9 9 9	9 9 9	9 9 9	9 9 9	x

FIGURE 3 Class Profile

The solution, we feel, designed to save money as well as reduce errors and increase efficiency, is to tie all the applications with a Master Record System, so that, in effect, an element appears only once. This is the concept of the Pupil Master Record System (PMRS).

Such a system keeps each of the working applications in step. It keeps up with pupil movement throughout the school district because the records are by student, not by school. It saves money and processing time. One example is avoidance of multiple physical examinations in the instance where a pupil, as does happen, transfers through 3 schools in the district within one year.

The concept we feel is as applicable to a manual school system as an automated one.

WHY HAVE A PUPIL FILE?

Consolidation of records has certain advantages but there are other opportunities within a school system to consolidate, for example, in staff and professional accounting. The advantages of doing the same for students are achievement oriented, Figure 2. That is to say, they are directed toward measuring progress toward educational goals such as performance. They measure social progress, for example degree of racial integration. Also they measure projective results, in that they serve as a planning base.

Having a central file is a boon to researchers. It provides a ready base for random and controlled sample selections. For the classroom teacher it provides an "instant" profile, in that it can be used as the source of a condensed document drawn from each pupil's entire school history. The latter is in the Master Record. It is a straightforward manual or computerized procedure to provide each teacher on opening day with such a profile for her entire class, Figure 3.

HISTORY OF ONE PROJECT (THE PUPIL MASTER FILE)

How did we become involved with the Pupil Master Record concept? As a general consulting company we have several divisions which work in education. Our Computer and Information Sciences Division worked with Montgomery County to automate a Master Record System called the Pupil Master File.

There are approximately 125,000 students in the Montgomery County Public School system. In order for the Montgomery County Public Schools to satisfy the administrative and information handling requirements of the large school population, it has developed a number of computer applications (e.g., Pupil Scheduling). For such applications to work effectively and to render data in a cost-effective way, without redundant manual data preparation, a centrally available data base was necessary for the student population.

The Office of Educational and Managerial Information and Analysis (OEMIA) of the Montgomery County Public Schools (MCPS) has been working for a number of years to develop such a school information system to meet the total information management needs of the Montgomery County Public Schools. The system comprises five subsystems. Pupil, Personnel, Finance, Materials, and Facilities. The Pupil Subsystem consists of several applications, including Pupil Accounting, Pupil Scheduling, Pupil Testing, Pupil Performance Reporting, and Pupil Health Data. The Pupil Master File (PLMF),

another application within the Pupil Subsystem, was to be developed with contractor support. It was to be a well-integrated part of the Pupil Subsystem and an orderly step to the complete School Information System (SIS). Under the contract, ORI carried out the design and development of the Pupil Master File.

The Pupil Master File expands and enhances the Pupil Subsystem and expedites administrative tasks within the MCPS. It provides a planning base for addressing the education needs of the student population now and in the future. The PLMF is the archive of certain data for such applications as Pupil Performance, and the central repository of information generated by other applications such as pupil testing. It thus represents a data base from which reports of interest to the county and to the state may be generated and upon which studies may be conducted as required from time to time. In the latter case, sensitivity and confidentiality are critical considerations. It was therefore essential that controls be built into the data base to prevent abuse of otherwise private or quasi-private information.

An additional constraint upon the development of the Pupil Master File was the urgency for early completion of the system design and for early demonstration capability. The demonstration made use of new forms and new data acquisition procedures which would subsequently be used in the administration of education activities for the next school year.

DESIGN OF A PUPIL MASTER RECORD SYSTEM

Our concept for any operational system calls for a basic closed loop underlying the system structure. The PMRS may be readily so structured, Figure 4.

It is essential that there be feedback from users of the output so that errors are corrected as far as the data are concerned, and so that formats are legible and readable. Further, the cycle must be complete so as to insure that no data are collected unnecessarily and so that everything that is required is generated.

It must be emphasized that the user requirements are the sole criteria for system structure. Those for the Montgomery County system were worked out over a period of 8 years and are very detailed. The general criteria, however, can be expressed in eight major objectives:

a. Establish a master file that will enable implementation of the Maryland Board of Education's Pupil Data System (PDS). [1/]
b. Provide interface compatibility with the other applications in the Pupil Subsystem, as well as other subsystems.
c. Provide effective safeguards and procedures to protect the confidentiality of all confidential information stored in the file.
d. Provide access to the file for retrieval of all data items either individually or in combination with other data items in the PLMF, in other applications within and outside the Pupil Subsystem.

[1/] Maryland State Board of Education Resolution No. 1972-20, 31 May 1972.

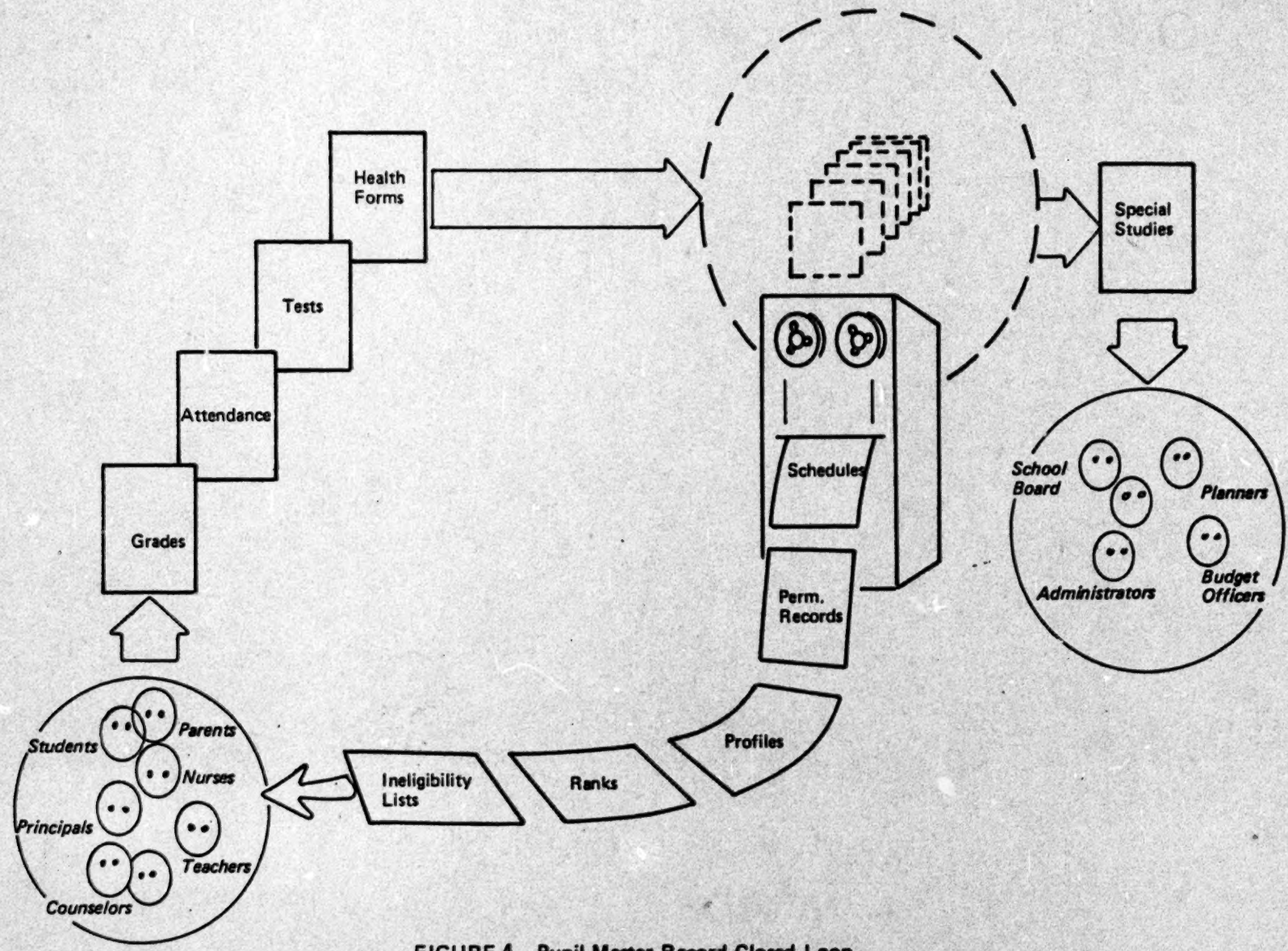


FIGURE 4 Pupil Master Record Closed Loop

e. Design the file structure to facilitate outputs of certain specific reports, listings, statistical summaries, and individual data items on a periodic or on-demand basis.
f. Design the input forms and procedures so that their use involves the minimum effort by data processing and operating school personnel.
g. Design the file structure to facilitate input of updated data and therefore assure that the file meets the currentibility requirements for each use.
h. Design the file structure to enable addition or deletion of data elements as the profile of user requirements changes with time. Also design the PLMF to permit conversion to on-line operation at an early date.

The first of these eight general requirements originated on 27 August 1969 when the Maryland State Board of Education approved the Maryland Pupil Data System (PDS) Manual of Instructions, and more recently when the Board passed the resolution calling for PDS implementation. The improvement and individualization of programs and services for pupils are the goals of the PDS concept. County pupil data systems are required to adhere to the minimum standards for the PDS but may adapt input procedures to render them compatible with their school operations. Adaptation may include the addition of data elements or the redesign of data collection forms to facilitate ease of computer input.

The second general requirement is provision of interfaces with Pupil Subsystem applications as well as other applications. The file is now structured to provide input from and/or outputs for other applications within the Pupil Subsystem, as well as other subsystems. In some instances, an entire PLMF data element category will be related to an application, while in other instances only some of the elements in a category will be related.

The provision of confidentiality safeguards and procedures was the third requirement of the PLMF design. Values for data elements which individually or which, when correlated or combined with others, are personally sensitive are retrievable only by personnel of assigned categories and/or levels. (A single breakdown of such safeguards could, if sufficiently significant, undermine the acceptance and utility of the PLMF and even eliminate the possibility for its existence.)

Access to the data on an individual or combined basis and the facility for providing outputs in a scheduled or unscheduled mode were the fourth and fifth general PLMF requirements. These requirements impacted the file structuring aspect of the PLMF design. Data elements required for outputs which are most frequently output are stored in the most accessible part of the file. The statistical reports which emanate automatically from the PLMF reside in such a part of the file, called the General Access File (GAF).

The sixth general PLMF requirement was to design input forms and procedures so their use will require only minimum effort by data processing and operational school personnel. If forms were not readily usable by operational personnel, they would not complete them correctly, if at all, and the PLMF would be rendered incomplete. However, from the data processing standpoint, these forms had to be designed for direct OCR system input even though such forms are difficult for operational personnel to use. Consequently, form design involved trade-offs between minimizing school operational and data processing personnel effort for file input.

Closely related to the "ease-of-file input" requirement was the file update requirement. For certain data elements values must be updated at certain times in the school year cycle to permit functions of certain applications. Not only did the file have to be structured to allow update, but new update forms and procedures had to be implemented.

Designing flexibility into the PLMF configuration was the eighth general requirement. In the future data elements may be added, deleted, restructured, lengthened, shortened and/or shifted to other fields, files or records. Also future operations may call for conversion of system operation to the interactive on-line mode. The File structuring design facilitated restructuring and/or conversion to on-line with a minimum of programming.

The PMRS concept that ORI has designed and developed meets these eight criteria. The design reflects our position that the PLMF is not merely a bottomless well into which information on Montgomery County students is perpetually dropped. Rather, it is a working file which exists as one component of a fully developed circuit or circle of information flow. It has inputs which are modified by updates and recorded in the file, certainly, but the file exists to provide outputs, and these outputs themselves are part of what we call the Pupil Master File. In other words, our concept is that the PLMF should be part of a working program of inputs and outputs, information sources, and users, linked together by a disciplined set of manual procedures and computer hardware and software facilities. Therefore the design is a very extensive one and includes as components of the PLMF some operational programs which may previously have been viewed only as adjuncts to the application.

It would take too long to go through the design details which provided software to meet the design criteria. The work can, however, be highlighted as follows:

At the end of the school year, or more properly, just prior to the beginning of the new school year, the data for students who have graduated will be extracted by the data extracting program and condensed into a Pupil Master File -- Graduate Data, MGF.

We did not recommend that programs with PLMF application interface directly with the PLMF tapes. Rather we recommended the use of a record interface program (RIP) with its open and close components for the following reasons:

- To provide confidentiality safeguards by insuring that programmers writing programs to access the master file use only the standard access method
- To maintain file integrity by insuring that only a fully debugged and 100% quality assured program is used in file reading and writing operation
- To provide for file expansion and contraction by making user programs oblivious to the actual file organization, which would permit adding and deleting elements and expanding and contracting the size of particular elements
- To permit the file to be changed in mode if necessary to a variable length format or even to a direct access device.

The above objectives are achieved by having all programs interface to the file through a common I/O routine. One particular advantage is that old application programs continue to run irrespective of the changes that have taken place within the file itself, thus reducing the overall cost of maintaining the system while at the same time permitting the system to be extremely flexible in accommodating the changing needs of the MCPS.

Inputs to the Pupil Master File come from two broad areas. The first area is existing applications, including the Pupil Scheduling Application, the Pupil Accounting Application, and the Pupil Testing Application. From files created by these applications, data are extracted on a routine basis for the PLMF. For example the yearly Master Schedule are read and input into the PLMF. The transactions occurring in pupil accounting are accumulated on a weekly basis and updated into PLMF. The pupil testing data generated after each testing wave are extracted and provided as updates for the PLMF.

A profile generator was designed to play back all the data under a particular student's name in his file. This profile generation program is very flexible. For example, it is able to provide the entire profile on a given individual for a particular data section on a given individual. The term data section, or data category, applies to the grouping ORI has developed for the data in the file. For example, personal information is one data section, performance data are another data section, and health and psychological data are still another data section. The profile generation program is also capable of generating the same data section for a number of students, e.g., the standardized test data on all students in a particular class or a particular school could be printed out at one time. These profile data sections come out in a predesigned format, this format has been selected to be as generally applicable as possible and in particular two of the data sections replace PDS 1 and PDS 5.

Finally, there exists a statistical capability which works off the General Access File (GSF). It will tabulate and compute percentages for any of the 600 data elements in the records of any or all pupils in the county.

For example, the reports will show racial balance for elementary schools in the upper county. Likewise it can extract, by changing control cards, a list of all 5th graders scoring higher than 90% on a particular test.

The statistical capabilities include the power to select a random sample of students who fit parametric parameters, such as 6 - 9 grade, female, with no siblings.

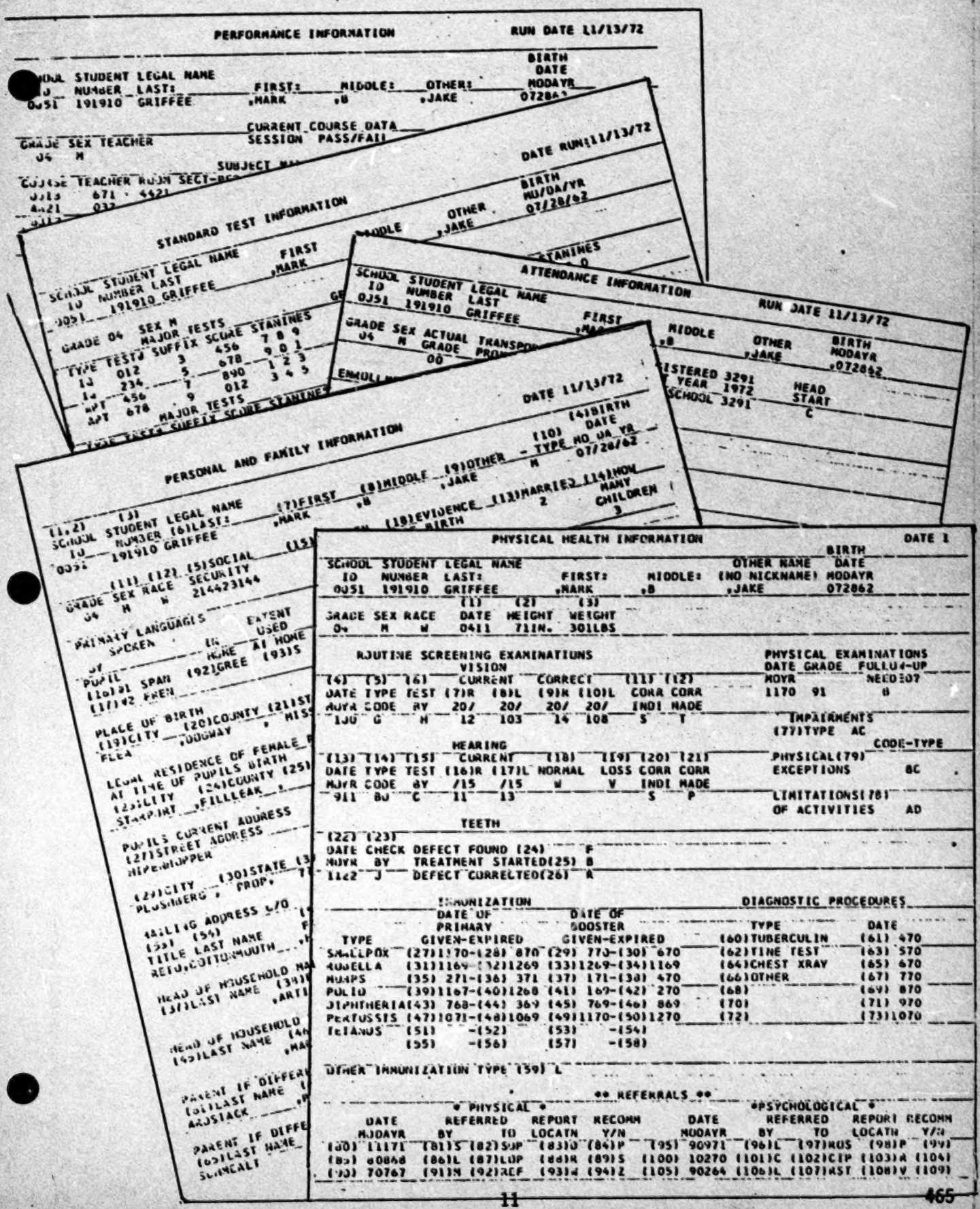
This is a very significant tool for researchers.

SIGNIFICANCE OUTSIDE MONTGOMERY COUNTY

Briefly, what the County and ORI jointly envisioned was the maximum applicability to all situations of the PLMF as an embodiment of the PMRS.

The technology was designed for transferability. The software is COBOL. The implementation was on IBM S/370 equipment. The file itself is access method and volume independent.

FIGURE 5 Typical Output Forms



PERFORMANCE INFORMATION — RUN DATE 11/13/72

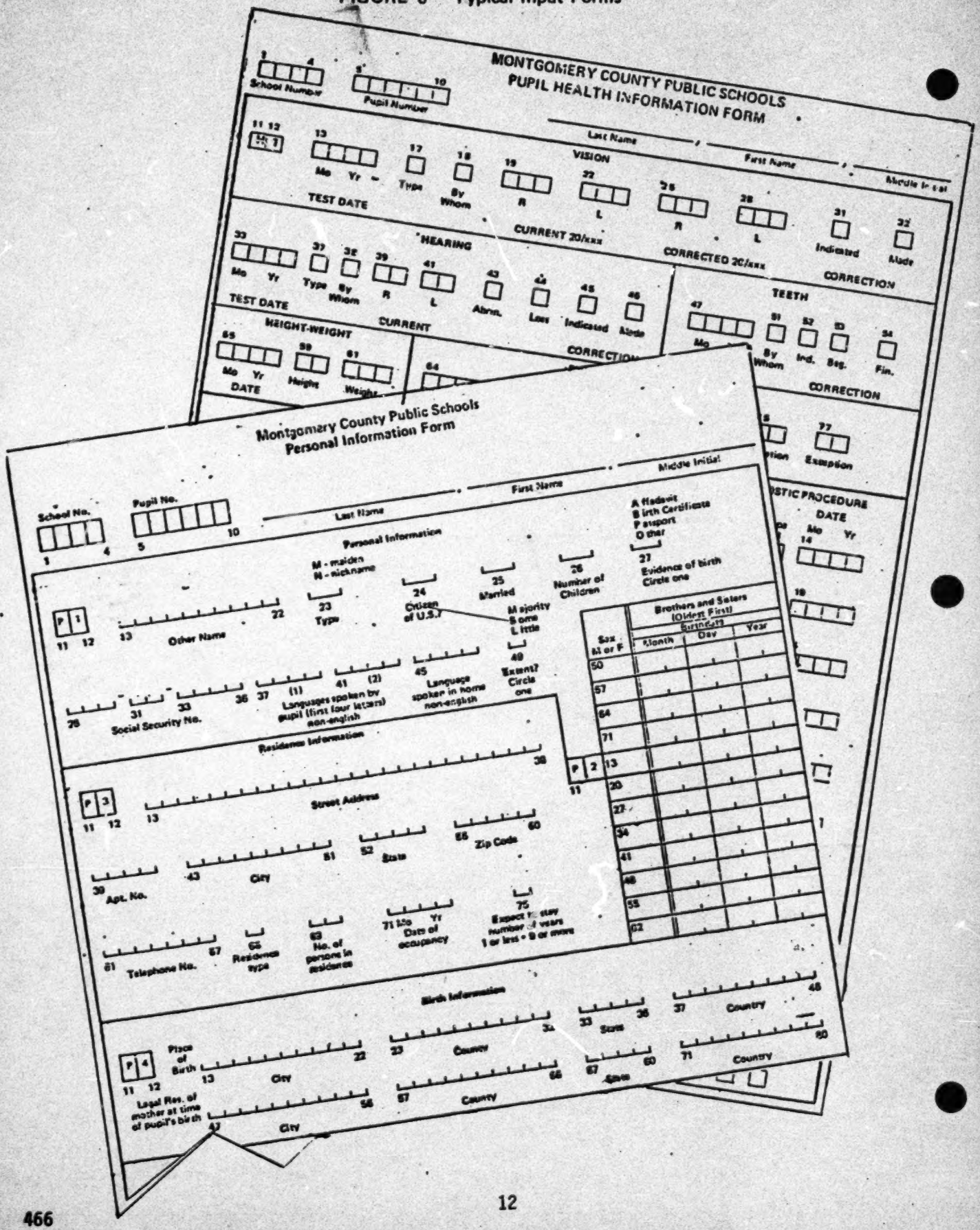
STANDARD TEST INFORMATION — DATE RUN 11/13/72

ATTENDANCE INFORMATION — RUN DATE 11/13/72

PERSONAL AND FAMILY INFORMATION — DATE 11/13/72

PHYSICAL HEALTH INFORMATION — DATE I

FIGURE 6 Typical Input Forms



Even without hardware a school district can use the basic PLMF design results. For example, the analyses performed by ORI and the County are based upon much that makes up the Common Core Data under development by the U.S. Office of Education.

The forms that were designed and the reports which emanate from the system data base reflect an organized approach to maintaining school system information in a central store. The analysis report, specifications and user manual are in print and have been distributed throughout the State of Maryland.

HOW TO USE THE PUPIL MASTER RECORD SYSTEM

Given the increasing likelihood of nationwide pressure to structure school data along lines suggested in the Common Core Handbook, we can expect that more and more school districts will want to explore use of an off-the-shelf system in full operational status. We would suggest the following approaches, depending on the situation in each district.

A school district presently using manual systems could utilize the PMRS through a local service bureau. The inputs and outputs, Figures 5 and 6 would be unaffected.

An individual school district already automated could connect its existing applications via the PMRS just as Montgomery County did. Consortia of school districts could use one software PMRS and a shared data base or individual district data bases. Again, the PMRS is indifferent to the order of magnitude or complexity of the difference among the Districts.

Finally, we anticipate that a state could have its Computer Center supply PMRS Support to all its districts which apply. They would use the PMRS over communications lines just as regional consortia might.

SUMMARY

The PMRS and its usefulness to the educational community may be summarized by saying that: The PMRS is an already-developed, operational system. The cost of the system design and software development has been paid. The system is currently operative with a pilot data base. The PMRS runs on IBM 360/370 equipment or other hardware that supports COBOL. The PMRS can be installed on existing compatible school system hardware or in a service bureau enviornment, in a batch or time-share mode, with operational, user and administrative instruction and training, or with software modifications to meet unique needs and requirements. It is operational in Montgomery County. The County is enthusiastic about it. The PMRS ties many disparate pupil applications together and provides the County new capability with significant savings in cost.

We at ORI are enthusiastic about the system and we are prepared to continue to enhance its usefulness to the educational community in every way we can.